

RAMAN SPECTROSCOPY

The Need

In November 1998, a demonstration was completed evaluating Field Raman Spectroscopy. The intent of the demonstration was to use Field Raman Spectroscopy to provide rapid quantitation of radiological constituents to assist in the D&D process. Currently, quantitation of individual radioactive contaminants within a particular facility is performed by taking swipes, then sending those swipes to a standard laboratory for analysis. These analyses have taken weeks to complete, and have been very costly. The objective of this demonstration was to determine if the standard laboratory analysis could be replaced by a field portable Raman Spectroscopy Unit which could provide a rapid qualitative and quantitative tool for the analysis of swipes. Fernald's Plant 1 was selected for this and other technology demonstration projects due to timing - it was a major production building undergoing demolition, while being executed on a defined schedule.

Dozens of buildings and support structures in the former 136-acre production area at Fernald are targeted for dismantling. In order to provide the proper radiological postings, personnel monitoring requirements, and access requirements, radiological characterization must be performed routinely. By using rapid, in situ techniques, the time and monies spent to perform these analyses can be significantly reduced.

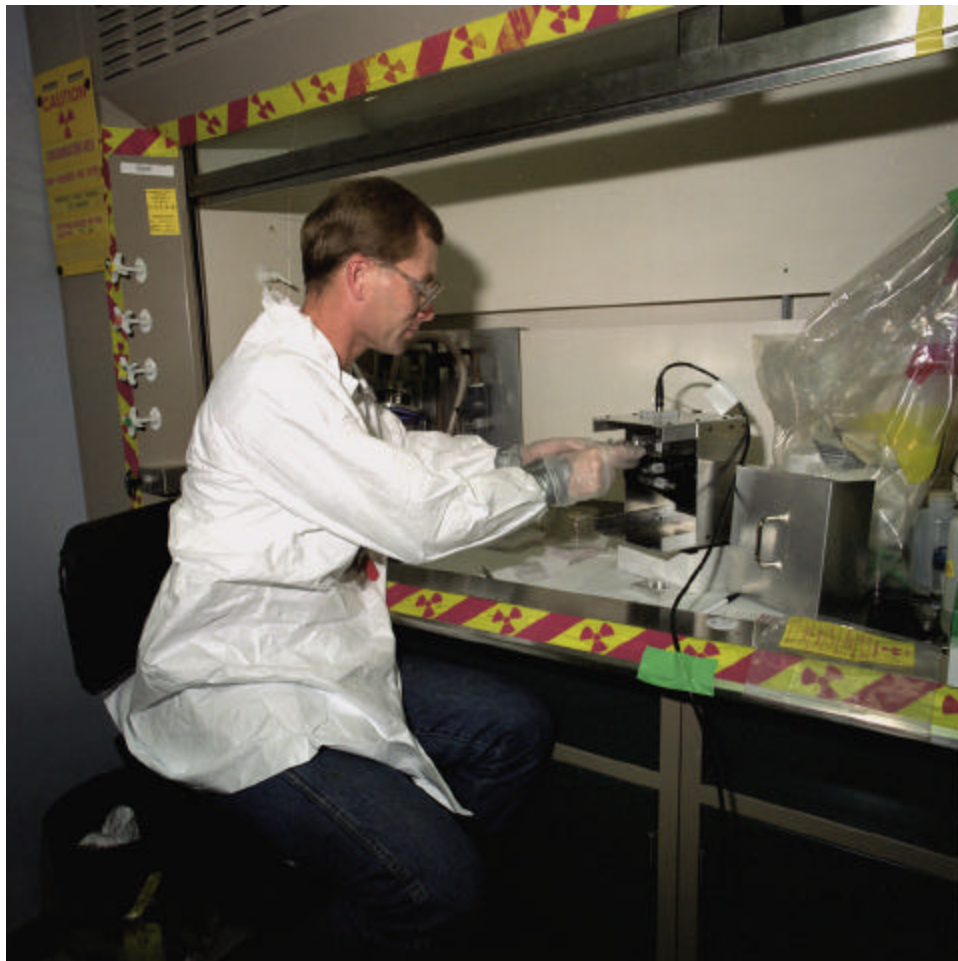


Figure 5. Raman Spectroscopy, EIC Laboratories.

The Technology

The Field Portable Raman Spectroscopy instrument was developed by EIC Laboratories in Norwood, Massachusetts using funding from the Radioactive Tank Waste Focus Area of the DOE Office of Science and Technology. The unit is fully developed and is commercially available. The Field Portable Raman Spectroscopy instrument works by exposing surfaces to laser light and detecting light that is inelastically scattered back. This inelastic scattering is known as the Raman effect. The varying wavelengths of the inelastically scattered light are characteristic for each compound. The intensity of the scattered light provides a means for quantifying contaminants.

The Demonstration

The Field Raman Spectroscopy demonstration was conducted using swipes collected from the Fernald Plant 1 complex. Despite some very positive aspects of the technology, Field Raman Spectroscopy did not prove to be a viable technique for the analysis of radiological swipes at Fernald. The instrument was unable to provide any characterization or quantitative data on the collected swipes. Several factors contributed to the poor results, including the poor scattering efficiency of Uranium Oxide (U_3O_8), interference caused by surface dirt collected on the swipes, the small area on the swipe used for analysis, and the heterogeneous deposition of contaminants on the swipe.

Results

Even though the Raman technique did not prove to be a valid solution for the characterization of surface contamination to support Fernald facility D&D, the methodology has application in other conditions. Raman Spectroscopy appears to have its best application using more homogenous mixtures such as liquids, and has been used to characterize organic mixtures. The Field Raman Spectroscopy technique could provide qualitative information of the contents of waste drums, containers, or tanks.